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Logistics Operations School
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Training Command
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FESCR 8206

STUDENT OUTLINE

REPAIR CUMMINS FUEL PUMPS

LEARNING OBJECTIVE

1. Terminal Learning Objective: Given a Cummins fuel pump, the required common and special tools, test equipment, repair parts, shop supplies, TM 9-2320-272-34, Cummins service bulletins, and Hartridge operating and servicing manuals, per information contained in the references, repair the fuel pump. (8.2.4)

2. Enabling Learning Objectives: Given a Cummins fuel pump, the required common and special tools, test equipment, repair parts, shop supplies, TM 9-2320-272-34, Cummins service bulletins, and Hartridge operating and servicing manuals, per information contained in the references:

a. Disassemble the fuel pump, (8.2.4a)

b. Inspect the disassembled components for serviceability, (8.2.4b)

c. Repair or replace the unserviceable components, (8.2.4c)

d. Assemble the fuel pump, and (8.2.4d)

e. Calibrate the fuel pump. (8.2.4e)

OUTLINE

1. DESCRIPTION AND PRINCIPLES OF OPERATION OF CUMMINS FUEL PUMPS

a. Description

(1) The Cummins pump that you see in front of you is a PTG-AFC plugged pump.

(a) As you already know, the PTG stands for Pressure-Time, Governor-Controlled.

(b) The AFC stands for Air-Fuel Control. The AFC unit is used on turbocharged engines and helps control the air-fuel ratio during acceleration.

(c) The word plugged is used to indicate that the AFC unit is not installed and the hole where it would be is plugged.

(2) The PTG-AFC-VS pump will also be covered later in this lesson. The letters VS stands for Variable Speed. A variable speed governor is incorporated into the pump when a requirement calls for controlling a constant speed.

(3) The fuel pump nameplate will contain the pump code number. You must have the correct pump code number to ensure the right repair parts are ordered and to obtain the correct calibration specifications.

b. Metering of Fuel

(1) Changing any one of or a combination of any of the following can vary the amount of fuel allowed to flow:

(a) The size on the passage, through which the fuel flows, referred to as flow area. The total flow area is determined by calibration of a complete set of injectors.

(b) Fluid pressure at the inlet of the injector. The fuel pump controls this pressure, referred to as rail pressure.

(c) The time fuel is allowed to flow, which is controlled by the speed of the engine trough the rotation of the camshaft.

(d) The relationship between these three is the essence of metering fuel in the Cummins PT fuel system

(2) In this system, the container into which the fuel is metered is the injector cup. The three previously mentioned variables, fuel pressure, flow time, and the flow area control the amount of fuel metered per cycle.

(3) Remember, with a given flow area, (calibrated set of injectors) the metering of fuel is controlled by the rail pressure and flow time. However, we have no direct control of the time because it is controlled by engine speed through a camshaft-actuated plunger. The plunger movement opens and closes the metering orifice in the injector barrel. When the cam

follower roller is on the outer base circle of the camshaft injector lobe, closing of the metering orifice takes place.

(4) However, when the cam roller is on the inner base circle and the injector return spring has lifted the injector plunger, uncovering of the metering orifice occurs. The period of time the metering orifice is uncovered is the time available for fuel to flow into the injector cup. This is commonly referred to as the metering time.

(5) Again, with a given camshaft, metering time is controlled by engine speed. Metering time is inversely proportional to engine speed: the faster the engine speed the less time there is to meter the fuel.

(6) The CPL (Control Parts List) identifies the injector and camshaft assemblies to be used with any particular engine model. This establishes the total flow area and fixes the metering time at each speed for the engine.

(7) At any given speed, this leaves only the rail pressure to the injectors to control the quantity of fuel metered per cycle in the PT fuel system. The function of regulating rail pressure to the injectors takes place within the fuel pump. The PT fuel pump is designed and calibrated to provide the correct rail pressure during all engine-operating conditions.

(8) The fuel pressure supplied to the injector is referred to as rail pressure. With the throttle in the wide-open position, maximum rail pressure occurs at rated engine speed.

(9) It is important to understand that at any engine speed, the quantity of fuel metered into the injector cup per cycle, determines the amount of torque the engine develops. As we know, torque is the result of the downward force exerted on the piston by the combustion of metered fuel. The magnitude of this force is determined by the quantity of fuel injected per cycle, which is controlled by the rail pressure.

(10) We have determined that torque is dependent upon the amount of fuel metered and injected per cycle. It follows that at torque peak, the greatest quantity of fuel must be metered and injected per cycle. But, how can this happen if rail pressure, as we discussed earlier, is greater at rated speed than at torque peak speed?

(a) The answer is, at torque peak; the engine is turning at a slower speed, which means there is more available metering time, indicated by the shaded areas. Even though the fuel pressure is lower at torque peak speed than at rated speed, the increased metering time results in a greater amount of fuel being metered and injected per cycle at torque peak.

(b) Now, even though the engine burns more fuel per cycle at torque peak speed than at rated speed, it will burn more fuel per hour at rated speed. The reason for this is that there are more injection cycles at rated speed than at torque peak speed. Even though less fuel is injected per cycle at rated speed, the greater number of cycles results in greater fuel consumption in a given period of time.

(11) We've seen that the quantity of fuel metered and injected per cycle determines engine torque at any given speed. Here we see the relationship of rail pressure and available metering time to the torque produced at any given speed. We've identified torque peak speed and rated speed as two key points in the engine operating range.

c. <u>Fuel Flow through the Pump</u>

(1) The basic functions of the PTG-AFC fuel pump are to provide:

(a) For the transfer of fuel from tank to engine,

(b) Rail pressure to the injectors,

(c) Idle speed governing,

(d) Maximum speed governing,

(e) Operator control of power output below governed speed,

(f) Shutdown of the engine, and

(g) Control of exhaust smoke during acceleration. This function applies to those pumps, which have the AFC unit installed.

(2) A gear pump is located at the rear of the fuel pump assembly. It is driven at engine speed by the fuel pump mainshaft. Fuel from the tank enters the inlet or suction side of the gear pump and is carried around the outside of the two meshing gears to the outlet or pressure side of the gear pump.

(3) From the gear pump, fuel flow through a wire mesh magnetic filter to the inlet, or supply passage of the automotive governor. The governor assembly performs three functions:

(a) Pressure regulation,

(b) Idle-speed governing, and

(c) Maximum-speed governing.

(4) Before discussing these functions, let’s look at the makeup of the governor assembly.

(5) The position of the governor plunger is important to our discussion of the functions that take place within the governor assembly. At any speed, the position of the governor plunger is determined by the balance between the flyweight force exerted on one end of the governor plunger and the spring force applied to the opposite end of the plunger.

(6) The flyweights are driven through gears by the fuel pump mainshaft. The governor plunger is held between the flyweight feet and rotates with the flyweights. Any rotation creates a tendency for the flyweights to move away from their axis of rotation, which is the centerline of the weight carrier shaft. This outward push is known as centrifugal force.

(7) The rotating flyweights pivot on the flyweight pins. Through this pivoting action, an axial force is exerted on the governor plunger, through the flyweight feet. At any given speed, the balance between this flyweight force and spring force determines the plunger position.

(8) Given specific flyweights and springs, changes in speed will change the flyweight force applied to the governor plunger. This change in flyweight force will change the plunger position because it changes the point at which the weight force and spring force will balance. At any given speed, changes in the flyweights, the springs, or both, can, and in most instances will, change the plunger position.

(9) Think about these two modes of engine operation and the specific springs influencing the governor plunger position at that particular time. Around idle speed, the governor flyweight force is opposed by the idle spring. At speed close to but below torque peak speed, the flyweight force is opposed by the governor spring.

(10) During engine operation at speeds between torque peak speed and rated speed, a combined spring force of the governor spring and the torque spring balances the flyweight force. Once the torque spring is engaged, it opposes the flyweight force exerted on the governor plunger. This results in a reduction of the flyweight force, which affects the governor plunger position.

(11) The control of rail pressure in the PT fuel system begins by regulating the fuel pressure supplied to the governor assembly appropriately called supply pressure. The control of this supply pressure

is accomplished through the use of a by-pass type pressure regulator incorporated within the governor assembly. This type of pressure regulator is designed to unseat when a designated supply pressure is reached.

(12) For this type of regulator to function, an excess supply of fuel must be delivered to the governor assembly. This ensures that, during fuel pump operation, some fuel is always being by-passed, enabling the regulator to maintain control of the supply pressure. The gear pumps used in the PT fuel system are designed to deliver more fuel than is required to operate the engine. Excess fuel by-passed from the pressure regulator is returned to the gear pump inlet. This feature allows the pump to compensate for variations in gear pump capacity caused by parts tolerances and wear, thus minimizing the effects of these variations on the supply pressure.

(13) When the fuel pressure exerted on the button exceeds the forces holding the button and plunger together, the button is unseated and fuel is by-passed to the suction side of the gear pump. Therefore, the by-pass regulator maintains the supply pressure by unseating the button at the designated pressure and bypassing the excess fuel.

(14) The spring force acting on the button and the recessed area of the button determines the pressure at which the button separates from the governor plunger. The recessed area, or counterbore, is the specific area the fuel is pushing against.

(15) For a given spring force acting on the button, increasing the recessed area reduces the pressure at which the fuel begins bypassing, thereby lowering the supply pressure. Notice that on the right side of the slide that decreasing the recessed area will have the opposite effect, fuel will begin bypassing at a higher pressure, raising the supply pressure.

(16) Changing the recessed area of the button will change the height of the supply pressure curve. A button of a smaller recessed area will raise the supply pressure curve, while a button with a larger recessed area will lower the supply pressure curve.

(17) Also, with a given recessed area, any change in plunger position will change the force on the button and change the supply pressure. As we can see in this example, increasing speed changes the plunger’s position, increasing the force on the button, which raises the supply pressure.

(18) The supply pressure is a function of the force acting on the button and the area of the button recess. It is important to understand

that there is a unique supply pressure for each speed, and that this supply pressure is independent of the flow out of the pump.

(19) We have now discussed pressure at two different locations in the fuel system. The first was pressure to the injectors, which is referred to as rail pressure. In the PT fuel system, at any given speed, the rail pressure controls the quantity of fuel metered per cycle and, therefore, engine torque. The second pressure we discussed was the pressure supplied to the governor, which is called supply pressure. The regulation of the supply pressure is the fist step in controlling the rail pressure.

(20) The first component that we will discuss is the governor. A governor is a speed-sensitive device that automatically controls or limits the engine speed. It does this by varying the fuel delivered to the engine under changing operating conditions. There are many types of governors, but our discussion will be restricted to the limiting speed mechanical governor, or automotive governor, as it is known in the PT fuel system.

(21) The automotive governor controls idle governed speed and maximum speed by positioning the governor plunger cut-off shoulder over the appropriate fuel passage.

(22) Remember, the position of the governor plunger is determined by the balance between the flyweight force and the spring force. The weight assist and flyweight force is working against the idle spring force.

(23) In governing maximum engine speed, the forces acting to position the governor plunger include the flyweight force working against a combination of the torque spring and the governor spring. The flyweight force acts in the direction to close the main fuel passage, while the spring force acts to keep the main fuel passage open. Several items should be noted at this time.

(a) The weight assist spring no longer affects the governor plunger position.

(b) The idle passage has been closed by the governor plunger.

(c) The idle spring no longer affects the governor plunger position, as the button has bottomed in the idle plunger guide.

(24) When the engine exceeds its rated speed, the governor reduces the fuel supplied to the injectors. The speed at which the governor begins to decrease fuel pressure is called governor break. Governor break occurs when the governor plunger cut-off shoulder begins to restrict the main fuel passage. This means that governor break always occurs when the plunger

reaches a specific position. It is important to understand that changes to the spring or weight forces do not change the position at which the governor break occurs, but only change the speed at which the plunger reaches the governor break position.

(25) Two other terms often involved in a discussion of maximum engine speed include high idle and governor cut-off. The maximum no-load engine speed is known as high idle. Any time engine speed exceeds high idle, the main fuel passage is closed by the governor plunger. Governor cut-off occurs at the point at which the main passage is completely closed.

(26) The throttle shaft is located between the governor and the fuel pump discharge. It allows the operator to reduce the rail pressure, and therefore, the power to the level needed. It functions as a variable area orifice, varying the amount of fuel exiting the main passage of the governor. The total travel of the throttle shaft is limited by two stop screws located in the throttle shaft housing.

(27) Located within the throttle shaft is the fuel adjusting screw, which determines the maximum flow of the throttle shaft passage when it is wide open. It is used to adjust the rail pressure during calibration.

(28) While the throttle shaft is in the closed position, there is always a small amount of fuel flowing through the throttle shaft. This is defined as throttle leakage, and is required to keep the fuel lines filled with fuel to cool and lubricate the injectors when the throttle is closed.

(29) Throttle leakage is an important setting on the fuel pump. If set too high, it can result in slow deceleration and excessive carboning of the injectors. If set to low, it causes a hesitation in engine response when the throttle is reopened after a downhill run, and leads to injector plunger damage.

(30) When the throttle is in the closed position in the lower speed range, the small amount of fuel flowing to the injectors is insufficient to maintain engine idle speed. The necessary, additional fuel flows from the governor through the idle passage around the throttle shaft. The amount of fuel needed for idling is a total of the fuel flowing through the idle passage plus some throttle leakage flowing through the throttle shaft.

(31) With a given throttle leakage setting, closed-throttle idle speed is maintained by controlling rail pressure. This pressure is determined by the position of the governor plunger cut-off shoulder over the idle passage. The forces positioning the governor plunger include the flyweight force and the weight assist spring force, which are balanced by the idle spring force. The combined force of flyweights and the weight

assist spring act in the direction to close the idle passage, while the idle spring acts in the direction to open the idle passage.

(32) From the throttle shaft, fuel flows to the shutdown valve. Most shutdown valves are controlled by an electrically operated solenoid. In the shutdown mode, a spring washer seats a disc, preventing fuel flow out of the pump. When the solenoid is energized, the electromagnetic force that is created overcomes the force of the spring washer, unseating the disc, and permitting fuel to flow from the pump to the injectors.

d. Flow Valve, Cooling Kit, and Pulsation Damper

(1) First is the pressurized gear pump, which is used extensively at this time. Pressurized gear pumps incorporate a spring-loaded flow valve in the by-pass fuel passage between the governor assembly and the suction side of the gear pump. This pressurizing valve prevents fuel from flowing to the suction side of the gear pump until enough pressure is built up in the fuel pump housing to unseat the valve. By pressurizing the fuel pump housing, leaks are easier to detect and air is kept from entering the fuel pump assembly.

(2) In addition, a cooling kit elbow is attached to many of the gear pumps. It is designed to prevent overheating of the fuel pump assembly. It does this by bleeding some of the hot fuel, within the gear pump, through the injector drain line back to the storage tank. This results in cooler fuel from the tank being circulated through the fuel pump assembly. Overheating could occur when the throttle is closed and the load is pushing the engine as in periods of downhill operation.

(a) Inside the cooling kit elbow is a spring-loaded check valve. This valve is designed to prevent fuel and/or air in the injector drain line from draining back through the fuel pump assembly when the engine is not operating.

(b) During engine operation, gear pump fuel pressure unseats the valve and circulates some fuel back to the tank through the injector drain line.

(3) Finally, there is a pulsation damper connected to the pressure side of the gear pump to smooth the pressure pulsation's created in the fuel by the rotating gear teeth.

e. Air-Fuel Control Assembly

(1) With an AFC, the fuel flows from the throttle shaft to the AFC section of the pump. The AFC assembly is needed on turbocharged engines to provide the proper fuel pressure to the engine during acceleration. It

does this by controlling the fuel to the injectors to an amount compatible with the air supplied by the turbocharger. This effectively controls acceleration black smoke.

(2) The main components of the AFC assembly include a cover, piston assembly, spring, and barrel. The piston assembly includes a diaphragm, piston, and plunger.

(3) The AFC senses air pressure in the intake manifold. Changes in the intake manifold pressure change the position of the piston and the plunger, which is attached to the piston. The position of the plunger shoulder over the AFC inlet passage determines the amount of fuel delivered to the injectors during engine acceleration.

(4) Air pressure is applied to the diaphragm and piston through the inlet fitting of the cover. Increasing air pressure overcomes the AFC spring force, causing the plunger to move in the barrel. As the plunger moves, the passage is uncovered, and fuel flows through the AFC. As the air pressure continues to increase, the plunger is pushed in even further, uncovering more area until the fuel restriction is eliminated.

(5) When there is little or no air pressure applied to the AFC diaphragm, maximum fuel pressure and flow is controlled by the no-air adjusting screw. At this time, the plunger is positioned by the return spring to block the main fuel passage through the AFC. Under these conditions, all the fuel flow is around the no-air adjusting screw.

(6) From the AFC assembly or no-air adjusting screw, fuel flows through the shutdown valve to the injectors.

f. <u>VS-Variable Speed Governor</u>

(1) The VS pump is used on vehicles that require constant speed control, such as the wrecker when you use the boom for lifting another vehicle or object. The standard type governor cannot control the engine speed constantly below the full-load governed speed. The VS pump can be identified by comparing the size of it to the size of the pump we just covered. The model identification letters of this pump are the same as the pump that we have been discussing, except the letters VS has been added. They represent variable speed.

(a) The idler gear and shaft assembly is located in the lower portion of the VS governor and it drives the upper governor gear.

(b) The VS governor weights are behind the governor gear, and provide centrifugal force for the governor.

(c) The VS governor plunger is located behind the weights and it controls the flow of fuel through the VS governor.

(d) The VS idle spring is the small spring located behind the plunger and it controls the minimum VS governor speed.

(e) The VS maximum-speed adjusting screw and spring control the VS governor maximum speed.

(f) The VS idle adjusting screw is used to adjust the low speed of the VS governor.

(g) The VS throttle shaft is located at the rear of the governor, and it disengages the VS governor.

(2) The fuel is pumped from the tank to the automotive governor which, as you can see, is located in the lower pump housing. The automotive governor works the same way in this pump as it did in the other pump we discussed. The automotive governor controls the engine at all times, except when you are using the boom. This pump has two throttle levers, one for each governor. The VS throttle lever is spring loaded toward the full-fuel position and the automotive throttle lever is attached to the vehicle accelerator.

(3) To put the VS governor into operation, the manual throttle in the truck cab has to be set then the controls at the boom engaged.

(a) The first thing the operator does is engage the air clutch. As the clutch is engaged, air pressure is sent from the air clutch through an airline to a cylinder behind the VS governor throttle lever. At this time, a plunger is forced out of the cylinder and pushes the throttle lever to the idle position. Now the VS governor is in control and will cause the engine speed to remain constant, regardless of the load on the boom.

(b) While this is taking place, fuel that has passed through the automotive governor throttle shaft enters the VS governor. The VS governor plunger fits in a governor barrel that is stationary and has drilled fuel passages through it.

(c) The plunger is driven by the flyweights and is undercut at the center. Movement of the plunger in the barrel opens and closes the drilled passages and spring tension from this spring you see here opposes the VS governor flyweight force. At this time, the plunger will be positioned so that the shoulder of the plunger will have the main fuel passage uncovered enough to cause the engine speed to remain constant. When a load is applied to the boom, the engine will have a tendency to slow down. When this happens, the governor weights will sense this change in speed and will allow the spring tension to move the governor plunger toward an increase in fuel flow.

(d) When the load is dropped off the boom, the engine speed will try to increase. At this time, the governor weights will move out further and push the governor plunger toward the springs, throttling the fuel passage, which will cause the speed to remain constant.

(e) There is a high and low-speed adjusting screw located at the rear of the pump, so you can calibrate the VS governor when it is on the test stand. The high-speed screw cannot cause the engine to run faster than the setting of the automotive governor, but it can be set to reduce the maximum speed.

2. PROCEDURES REQUIRED TO REPAIR THE CUMMINS FUEL PUMP

a. Repair and calibration procedures for the fuel pump are contained in TM 9-2320-272-34, the Cummins service bulletins, and the Hartridge operating and servicing manuals that are available at each test stand. Use these in conjunction with this student outline to perform each task.

b. Cleaning the Pump Before Disassembly

(1) Clean the fuel pump.

(2) Explain to the instructor the procedures for cleaning the fuel pump.

c. Preoverhaul Inspection

(1) Inspect the fuel pump.

(2) Explain to the instructor the procedures for inspecting the fuel pump.

d. Remove Tamper Proof Material

(1) Remove the tamper proof material from the fuel pump.

(2) Explain to the instructor the procedures for removing the tamper proof ball and throttle shaft cover from the fuel pump.

e. Disassemble Fuel Pump into Subassemblies

(1) Remove the check valve.

(2) Remove the electrical shut down valve.

(3) Remove the pulsation damper.

(4) Remove the gear pump.

(5) Remove the magnetic fuel filter.

(6) Remove the front cover from the main housing.

(7) Remove the governor weight and carrier assembly.

(8) Remove the weight assist plunger, spring, and shims.

(9) Remove the governor plunger. Measure torque spring shims. Record reading. ______________

(10) Remove the throttle shaft.

(11) Remove the spring pack cover and spring pack assembly.

f. <u>Disassemble Fuel Pump Subassemblies</u>

(1) Disassemble the electrical shut down valve.

(a) Remove four screws holding the coil housing to the valve housing.

(b) Lift off the coil, shield, spring, valve and “O” ring.

(2) Disassemble the pulsation damper.

(3) Disassemble the front cover.

(a) Remove the pump drive coupling.

<u>1</u> Remove the capscrew and washer.

<u>2</u> pull the coupling with a ST-709 puller.

(b) Remove the drive gear.

<u>1</u> Pull the key from the shaft and gear with diagonal pliers.

<u>2</u> pull the drive gear from the shaft.

(c) Remove the tachometer drive assembly.

(4) Remove the main shaft, bearing, and seals.

Have Instructor Initial.

g. Inspect Fuel Pump Components

NOTE: Explain to the instructor the procedures for inspecting the fuel pump components.

(1) Inspect the check valve.

(2) Inspect the electrical shut down valve.

(3) Inspect the pulsation damper.

(4) Inspect the gear pump.

(5) Inspect the front cover assembly.

(6) Measure the weight carrier bushing. Record Reading. __________

(7) Inspect the pump housing.

(8) Measure the drive shaft bushing. Record Reading. ____________

(9) Inspect the drive shaft, bearing and gear.

(10) Inspect the tachometer drive assembly.

(11) Check the governor weight pins.

Circle One: Go or No-Go.

(12) Perform the weight assist protrusion measurement.

Record Reading. _______________

(13) Inspect the governor plunger assembly. Record Reading. ________

(14) Inspect all spring and make all required measurements.

(a) Governor spring part no. __________, Color code, free length, and load test _______/________at____________.

(b) Idle spring part No. __________, color code _________, free length ____________, and load test _______/_______ at __________.

(c) Weight assist spring part no. _______, Color code, free length, and load test _______/at __________.

(d) Torque spring part No. _________, color code ______, free length ____________, and load test _______/_______ at __________.

(15) Inspect the throttle shaft assembly.

Have Instructor Initial.

h. Assemble the Pump from Serviceable Components

(1) Assemble the front cover.

(a) Install the oil seals.

Have Instructor Initial. __________

(b) Install the main shaft.

(c) Install the retaining ring.

(d) Install the tachometer shaft assembly.

Have Instructor Initial. __________

(e) Install the tachometer drive gear.

(f) Install the tachometer drive gear key.

(g) Install the drive coupling, lockwasher and screw.

(h) Install the weight carrier assembly.

(2) Assemble the pulsation damper.

(3) Assemble the shutdown valve.

(4) Assemble the spring pack housing.

Have Instructor Initial. __________

(5) Assemble and install the throttle shaft.

Have Instructor Initial. __________

(6) Assemble and install the governor plunger.

(7) Install the pump housing to the front cover.

Have Instructor Initial. __________

(8) Install the gear pump.

(9) Install the pulsation damper.

(10) Install the fuel filter.

(11) Install the electrical shutdown valve.

(12) Install the check valve.

Have Instructor Initial. __________

3. CALIBRATE THE FUEL PUMP.

a. Mount Cummins Fuel Pump to Test Stand

(1) Mount the fuel pump on the AVM2-PC.

(a) Install adapter ring and secure with three Allen screws.

(b) Install drive adapter and secure with two Allen screws.

(c) Mount pump to adapter ring.

(d) Install drive disk and slide pump forward into drive adapter. (Leave air gap)

(e) Tighten table slide clamps.

(2) Find the procedures for mounting the Cummins fuel pump to the test stand in the Hartridge H.F. 491 Mobile Test Unit Operating and Servicing Manual.

(a) Attach supply line to rear of pump.

(b) Attach cooling kit line to the top of gear pump.

(c) Attach fuel outlet line to fuel shutoff.

b. <u>Perform Fuel Pump run-in Procedures</u>

(1) Install the throttle lever spring.

(a) Install from top of the throttle shaft lever to test stand.

(b) The spring will hold the throttle lever to the full-fuel position.

(2) Install the spring pack-adjusting tool.

(a) Remove the 1/8-inch pipe plug from the rear of the spring pack housing.

(b) Install the idle adjusting tool ST-984 into the spring pack.

(3) Lubricate the tachometer drive seal and gears to prevent wear during calibration.

(4) Open the below listed valves:

(a) Vacuum control valve (supply valve),

(b) Flow control valve, and

(c) Fuel shutdown solenoid valve (manual shutoff valve).

(5) Turn on air supply and water lines for AVM and 491.

(6) Turn on main power for both stands.

(7) Turn on computer for AVM.(ensure computer boots up)

(8) Select set-up screen utilizing the F-keys on top of the computer keyboard or utilize the pointer on the mouse.

(9) Select pump rotation.

(10) Set maximum speed limit on stand.

(11) Select voltage for shutoff solenoid.(use A voltage)

(12) Fuel temperature should be maintained between 32-38 degrees Celsius.

(13) Secure the governor throttle lever in the full-fuel position.

(14) Start the test stand.

(a) Push the “START” button on the fuel and drive.

(b) Select the F-12 key for speed control and select stand to operate at 450 RPM.

(c) Observe the sight glass in the flowmeter for air bubbles.

(d) If bubbles are present, work the pump throttle back and forth a few times to relieve trapped air.

c. Perform Gear Pump Test

(1) Start the test stand and operate at 450 rpm.

(2) The gear pump must pick up fuel without the aid of priming.

(3) Select the F-12 key for speed control and select stand to operate at 2100 rpm. The minimum flow must be 495 pounds per hour.

(4) Check the fuel flow again for bubbles.

(5) If bubbles are present, work the throttle several times to relieve trapped air.

(6) If bubbling persists, check the suction lines and fittings for leaks.

NOTE: Any gear pump failing to pick up fuel must be replaced.

(7) Back out the pump throttle shaft adjusting screw until the port is fully open. (Observe flow panel for highest reading.)

(8) Adjust the front throttle stop screw until the port is fully open. (Observe flow panel for highest reading.)

(a) Using an Allen wrench to turn the screw, adjust.

(b) The port is fully open when the fuel pressure peaks on the flow panel.

d. Test Pump Seals for Leakage (non-pressurized pumps only)

(1) Select the F-12 key for speed control and select stand to operate at 500 rpm.

(2) Place a small amount of grease over the weep hole.

(3) Close the supply valve until the vacuum gauge indicates 15 inches Hg.

(4) Open the supply valve.

e. Test Governor Cutoff RPM

(1) Use F-12 key to increase pump speed to 100 rpm below rated (line 3).

(2) Close the flow control valve until the flow meter reads the required pounds per hour of flow (line 17).

(3) Adjust the supply valve until 7 inches Hg. is indicated on the vacuum gauge.

NOTE: If you can't obtain seven inches Hg., check for a restriction in the test stand filter of the fuel suction line. This seven inches of vacuum simulates a dirty fuel filter within the vehicle fuel system.

(4) Use F-12 key to increase pump speed to the calibration rpm (line 16).

NOTE: Do not change the vacuum adjustment once it has been set. The vacuum will fluctuate during speed changes.

(5) Close the flow control valve until the flow meter reads the required pounds per hour of flow (line 17).

(6) Use F-12 key to increase pump speed, move analog trim switch to the speed position, and set analog trim range to 200 rpm. Slowly increase the analog speed control until the fuel pressure begins to decrease (peak point). This should occur between ______/______ rpm (line 8).

NOTE: The test stand must be shut off and completely stopped before opening the spring pack housing, because the pump is in a vacuum.

(7) Adjust the governor cutoff rpm.

(a) If the maximum governed speed is higher than specification, shims must be removed from the high-speed spring.

(b) If the cutoff is too low, shims must be added.

NOTE: Each .001 inch shim will change engine speed approximately 2 rpm.

f. Calibrate Throttle Leakage

NOTE: This setting controls fuel leakage inside the pump to control deceleration time, and keeps fuel in all lines during closed throttle operation, preventing air locks and damage to the injectors.

(1) Use F-12 key and operate the test stand at rated speed (line 3).

CAUTION: Do not hold the throttle lever in the idle position any longer than necessary to complete the test. The pump may overheat since fuel flow is used to cool and lubricate the pump.

(2) Open throttle leakage valve.

(3) Close the flow control valve.

(4) Hold the throttle in the idle position.

(5) Check fuel delivery. (Read small flow meter)

(6) Adjust the rear (back) throttle stop screw to obtain correct throttle leakage setting (line 11).

(7) Open flow control valve.

(8) Close throttle leakage valve.

NOTE: Always set throttle leakage before adjusting idle, as leakage affects idle.

g. Calibrate Idle Speed

(1) Use F-12 and operate the test stand at required speed (line 13).

(2) Secure the throttle lever in the idle position.

(3) Open the idle orifice valve.

(4) Close the flow control valve.

(5) Observe fuel pressure and adjust the idle adjusting screw to obtain the correct pressure (line 13).

(a) If the pressure is low, screw in the idle adjusting screw.

(b) If the pressure is high, screw out the idle adjusting screw.

h. Calibrate Throttle Lever Travel (stand may be shut-off for this adjustment)

(1) Place the angle gauge on the throttle lever.

(2) Move the throttle lever to the idle position.

(3) Move the throttle lever to the full-fuel position.

(4) Adjust the front throttle stop screw to obtain the correct degree of travel (line 12).

i. Calibrate Pump Manifold Pressure

(1) Open the flow control valve and close the idle orifice valve.

(2) Secure the throttle lever in the full-fuel position.

(3) Use F12-key and operate the test stand to required rpm (line 16).

(4) Turn the flow control valve and adjust the fuel flow to the required pounds per hour of flow (line 17).

(5) Adjust the supply valve to obtain 7 inches Hg. on the vacuum gauge.

(6) Observe the fuel manifold pressure.

(7) Adjust the throttle shaft adjusting screw to obtain the correct manifold pressure (line 16).

(a) To increase the fuel pressure, turn the throttle shaft adjusting screw counterclockwise.

(b) To decrease the fuel pressure, turn the throttle shaft adjusting screw clockwise.

j. Compare the Checkpoint Pressures

NOTE: The term “CHECKPOINT” No. 1 and No. 2 are used to describe testing the torque spring and weight assist plunger.

(1) Checkpoint No. 1, torque spring setting.

(a) Use F-12 key and adjust the test stand speed to the required rpm (line 18).

(b) Adjust fuel flow to the amount specified (line 19).

(c) Observe the fuel pressure (line 18) on the fuel manifold pressure gauge.

(d) The torque spring must be rechecked if the fuel pressure (line 18) is incorrect.

1 To increase fuel pressure at this checkpoint, shims must be added to the torque spring.

2 To decrease fuel pressure, remove shims.

NOTE: This setting causes the engine to deliver its maximum torque.

(2) Checkpoint No. 2, weight assist setting.

(a) Use F-12 key and set the pump test stand speed to required rpm (line 20).

(b) Adjust the fuel flow to the amount specified (line 21).

(c) Observe the fuel pressure (line 20) on the fuel manifold pressure gauge.

(d) If the fuel pressure (line 20) reading is incorrect:

1 Remove shims from the weight assist plunger to increase fuel pressure.

2 Add shims to the weight assist plunger to decrease fuel pressure.

NOTE: If the weight assist plunger shims or spring are changed, the pump must be recalibrate.

k. Remove Pump from Test Stand

NOTE: Before removing the pump from stand ensure that the computer is shutdown properly by utilizing the shutdown function on the display screen.

(1) Find the procedures for mounting the Cummins fuel pump to the test stand in the Hartridge H.F. 491 Mobile Test Unit Operating and Service Manual, and remove the fuel pump in the reverse order.

(2) Secure the adapter components to the proper storage area.

l. Install Tamper-Proof Material

(1) Return the fuel pump back to your workstation.

(2) Install the tamper-proof material.

m. Calibration procedures for Cummins pump with V-S Governor.

(1) The procedures for calibrating the Vs governor pump are exactly the same for the PTG-AFC plugged pump with the following differences:

(a) Prior to securing the governor throttle lever in full fuel position, back out the high and low adjusting screws four turns.

(b) Then, after you have performed all the procedures through checkpoint No. 1, calibrate the VS governor fuel pressure, using the correct specifications for the pump being calibrated are as follows:

1 Secure the automotive governor and the VS governor throttles in the full-fuel position.

2 Use F12 key and increase the test stand speed to the required rpm (line 16).

3 Turn the "VS" high idle screw in until the fuel manifold pressure starts to drop.

4 Use the F-12 key and analog trim to increase the pump speed to required rpm and gradually increase speed until fuel manifold pressure starts to drop. This should occur within the rpm range called for in the specifications (line 9).

5 Use F-12 key to decrease the test stand speed to the required rpm (line 13).

6 Secure the VS governor throttle lever in the "IDLE" position.

7 Open the idle valve and close the flow control valve.

8 Adjust the VS governor low idle screw to obtain the required fuel manifold/pressure (line 13).

(c) Once the VS governor pressure has been set, continue on with the procedures starting with checkpoint No. 2.

(2) Explain to the instructor the procedures for calibrating the VS governor fuel pressure.

Have Instructor Initial. _________

STUDENT REFERENCES:

TM 9-2320-272-34
Cummins Service Bulletins 3387213-01R and 3379084-2 Hartridge H.F. 491 Mobile Test Unit and AVM2 operating and servicing manual